WHAT IS CLAIMED IS:

1. A quadrature polarized antenna element comprising a plurality of electric dipoles arranged at a predetermined angle with respect to one another and a plurality of magnetic dipoles arranged at said predetermined angle with respect to one another, and wherein each magnetic dipole substantially shares a common location with a respective one of said electric dipoles.

2. The antenna element of claim 1, wherein said predetermined angle is substantially ninety degrees.

3. The antenna element of claim 2, wherein said plurality of dipoles are arranged to obtain electro-magnetic signal information from near to three dimensional surroundings.

4. The antenna element of claim 3, wherein said electromagnetic signal information is such as to allow extraction of at least one of a group comprising signal localization, signal polarization, and data content.

5. The antenna element of claim 1, wherein said electric and said magnetic dipoles are co-located.

6. The antenna element of claim 1, wherein said electric and said magnetic dipoles are respectively located with at least one half wavelength interval therebetween.

7. The antenna element of claim 1, arranged to detect signals from substantially throughout the azimuth plane, said electric dipoles and said magnetic dipoles being arranged to complement each other in respect of polarization information in said signals, thereby to enable said element to obtain substantially all polarization information within said azimuth plane.

8. The antenna element of claim 1, wherein at least one element comprises four dipoles.

9. The antenna element of claim 8, wherein two of said dipoles are electric dipoles, and two of said dipoles are magnetic dipoles.

10. The antenna element of claim 9, wherein said two electric dipoles are mutually orthogonal and said magnetic dipoles are mutually orthogonal, and wherein each of said magnetic dipoles is co-directed with one of said electric dipoles.

11. A quadrature polarized antenna array, comprising a plurality of antenna elements, each element comprising a plurality of electric dipoles arranged at a predetermined angle with respect to one another and a plurality of magnetic dipoles arranged at said predetermined angle with respect to one another, and wherein each magnetic dipole substantially shares a common location with a respective one of said electric dipoles.

12. The antenna element of claim 11, wherein said predetermined angle is substantially ninety degrees.

13. The antenna array of claim 12, wherein said dipoles are arranged to obtain signal information from near three-dimensional surroundings.

14. The antenna array of claim 13 wherein said signal information comprises at least one of a group comprising signal source direction, signal polarization, and data content.

15. The antenna array of claim 12, wherein said electric and said magnetic dipoles of at least one element are co-located.

16. The antenna array of claim 12, wherein said elements are respectively located with substantially half wavelength intervals therebetween.

17. The antenna array of claim 12, arranged for detection in the azimuth plane and wherein said electric dipoles are arranged to detect a first polarization component within said azimuth plane and wherein said magnetic dipoles are arranged

to detect a second polarization component orthogonal to said first polarization component within said azimuth plane, thereby to obtain substantially all polarization information within said azimuth plane.

18. The antenna array of claim 12, wherein at least one element comprises four dipoles.

19. The antenna array of claim 18, wherein two of said dipoles are electric dipoles, and two of said dipoles are magnetic dipoles.

20. The antenna array of claim 19, wherein said two electric dipoles are mutually orthogonal and said magnetic dipoles are mutually orthogonal.

21. The antenna array of claim 11, further comprising an electric switch for switching between dipoles or a switch for switching between elements to gather data over said array.

22. The antenna array of claim 12, having connected thereto a signal preprocessor for preprocessing signals from said antenna for obtaining spatial spectrum information for signal source location, the preprocessor comprising:
a sensor autocorrelator configured for forming signal autocorrelation matrices for each sensor type, and
a smoother configured for smoothing said autocorrelation matrices, thereby to form at least one covariance matrix comprising spatial spectrum information.

23. The antenna array of claim 22, having connected thereto a source locator configured for using said sample covariance matrix in an eigenstructure-based signal source localization technique.

24. The antenna array of claim 22, wherein said smoother is further configured to apply forward backward smoothing to said covariance matrix, thereby to increase a maximum number of signal sources that can be localized.

25. The antenna array of claim 23, wherein said preprocessor is further able to use a steering vector together with said covariance matrix in said source locator.

26. The antenna array of claim 12, having connected thereto a signal preprocessor for preprocessing signals from said antenna for obtaining spatial spectrum information for signal source location, the preprocessor comprising:
an autocorrelator, connected after an input from said elements, for forming signal autocorrelation matrices for each element, and a smoother, connected after said autocorrelator, for smoothing said autocorrelation matrices, therefrom to form a sample covariance matrix suitable for use in a Eigenstructure-based estimator for estimating source localization.

27. A method for preprocessing incoming signals obtained using a plurality of different sensor types, the signals including coherent signals, the preprocessing being for source localization, the method comprising
obtaining angle of arrival and polarization information of incoming signals from each of said different sensor types, forming signal autocorrelation matrices for each sensor type, and smoothing said autocorrelation matrices, to form therefrom at least one covariance matrix suitable for use in eigenstructure-based signal source localization techniques.

28. The method of claim 27, further comprising applying forward backward averaging to said covariance matrix, thereby to increase a maximum number of signal sources that can be localized.

29. The method of claim 27, further comprising obtaining a steering vector for use together with said covariance matrix in said eigenstructure-based signal localization techniques.

30. The method of claim 27, wherein said obtaining is from four sensor types.

31. The method of claim 30, wherein said four sensor types are two respectively orthogonal electrical dipoles and two respectively orthogonal magnetic dipoles.

32. The method of claim 31, wherein said four sensor types are all arranged for sensing in a single plane.

33. The method of claim 27, comprising using source localization information obtained from the data of said covariance matrix as an input to a beam director to provide a directed beam to a respective source.

34. The method of claim 27, wherein said incoming signal is a noise signal, the method further comprising using source localization information obtained from said covariance matrix as an input to a beam director to provide a null of a directed beam to a respective source of said noise interference signal.

35. A method for processing incoming signals obtained using a plurality of different sensor types, the signals including coherent signals, the preprocessing being for source localization, the method comprising obtaining angle of arrival and polarization information of incoming signals, forming signal autocorrelation matrices over an array of said sensors, and forming a sample covariance matrix from said signal autocorrelation matrices, said sample covariance matrix being suitable for use in a maximum likelihood estimator for estimating source localization.

36. The method of claim 32, wherein said maximum likelihood estimator is

$$(\hat{\theta},\hat{\phi}) = \arg\max_{\theta,\phi} \lambda_{\max}\left\{\underbrace{\mathbf{F}_T^H(\theta,\phi)\mathbf{R}_n^{-1}\hat{\mathbf{R}}_y\mathbf{R}_n^{-1}\mathbf{F}_T(\theta,\phi)}_{\Psi_2(\theta,\phi)}, \underbrace{\mathbf{F}_T^H(\theta,\phi)\mathbf{R}_n^{-1}\mathbf{F}_T(\theta,\phi)}_{\Psi_1(\theta,\phi)}\right\}$$

wherein:

θ - vector of the elevation angles of the sources,

ϕ - vector of the azimuth angles of the sources,

$\lambda_{\max}$ - maximum generalized eigenvalue of the matrix pair $(\Psi_2(\theta,\phi), \Psi_1(\theta,\phi))$

$\mathbf{F}_T(\theta,\phi)$ - matrix whose columns denote spatial transfer functions for both polarization components of the sources,

$(.)^H$ - matrix Hermitian operation (complex conjugate and transpose)

$\mathbf{R}_n$ - noise and interference covariance matrix

$\hat{\mathbf{R}}_y$ - sample covariance matrix.

37. The method of claim 35, comprising using source localization information obtained from said covariance matrix as an input to a beam director to provide a directed beam to a respective source.

38. The method of claim 35, wherein said incoming signal is a noise signal, the method further comprising using source localization information obtained from said covariance matrix as an input to a beam director to provide a null of a directed beam to a respective source of said noise signal.

39. Apparatus for preprocessing incoming signals obtained using a plurality of different sensor types, the signals including coherent signals, the preprocessing being for source localization, the apparatus comprising an input for obtaining angle of arrival and polarization information of incoming signals from each of said different sensor types, a sensor autocorrelator configured for forming signal autocorrelation matrices for each sensor type, and a smoother, configured for smoothing said autocorrelation matrices , thereby to form at least one covariance matrix suitable for use in eigenstructure-based signal source localization techniques.

40. The apparatus of claim 39, wherein said smoother is further configured to apply forward backward averaging to said covariance matrix, thereby to increase a maximum number of signal sources that can be localized.

41. The apparatus of claim 39, further able to use a steering vector together with said covariance matrix in said eigenstructure-based signal localization techniques.

42. The apparatus of claim 39, wherein said sensor types comprise four sensor types.

43. The apparatus of claim 42, wherein said four sensor types are two respectively orthogonal electrical dipoles and two respectively orthogonal magnetic dipoles.

44. The apparatus of claim 43, wherein said four sensor types are all arranged for sensing in a single plane.

45. Apparatus for preprocessing incoming signals obtained using a plurality of different sensor types, the signals including coherent signals, the preprocessing being for source localization, the apparatus comprising an input for obtaining angle of arrival and polarization information of incoming signals from each of said different sensor types, a sensor autocorrelator configured for forming signal autocorrelation matrices for each sensor type, and a covariance unit, also connected after said autocorrelator, for forming a covariance matrix from which a sample covariance matrix can be extracted, said sample covariance matrix being suitable for use in a maximum likelihood estimator for estimating source localization.

46. Apparatus for processing incoming signals obtained using a plurality of different sensor types, the signals including coherent signals, the processing being for source localization, the apparatus comprising

an input for obtaining angle of arrival and polarization information of incoming signals, an autocorrelator, connected after said input, for forming signal autocorrelation matrices for each element, and a covariance matrix, connected after said autocorrelator for forming a covariance matrix, from which a sample covariance matrix is extractable from said autocorrelation matrices, said sample covariance matrix being suitable for use in a maximum likelihood estimator for estimating source localization.

47. The apparatus of claim 44, wherein said maximum likelihood estimator

is $(\hat{\theta},\hat{\phi}) = \arg\max_{\theta,\phi} \lambda_{\max}\left\{\underbrace{\mathbf{F}_T^H(\theta,\phi)\mathbf{R}_n^{-1}\hat{\mathbf{R}}_y\mathbf{R}_n^{-1}\mathbf{F}_T(\theta,\phi)}_{\Psi_2(\theta,\phi)}, \underbrace{\mathbf{F}_T^H(\theta,\phi)\mathbf{R}_n^{-1}\mathbf{F}_T(\theta,\phi)}_{\Psi_1(\theta,\phi)}\right\}$

wherein:

θ - vector of the elevation angles of the sources,

ϕ - vector of the azimuth angles of the sources,

$\lambda_{\max}$ - maximum generalized eigenvalue of the matrix pair $(\Psi_2(\theta,\phi), \Psi_1(\theta,\phi))$

$\mathbf{F}_T(\theta,\phi)$ - matrix whose columns denote spatial transfer functions for both polarization components of the sources, (defined in (20))

^{H} - matrix hermitian operation (complex conjugate and transpose)

$\mathbf{R}_n$ - noise and interference covariance matrix

$\hat{\mathbf{R}}_y$ - sample covariance matrix.